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Relativistic Particle-In-Cell Simulation Studies of Prompt and Early Afterglows from GRBs KEN-ICHI NISHIKAWA, NSSTC/UAH, PHILIP HARDEE, UA, YOSUKE MIZUNO, NSSTC/MSFC, GERALD FISHMAN, NASA/MSFC — Nonthermal radiation observed from astrophysical systems containing relativistic jets and shocks, e.g., gamma-ray bursts (GRBs), active galactic nuclei (AGNs), and Galactic microquasar systems usually have power-law emission spectra. Recent PIC simulations of relativistic electron-ion (electro-positron) jets injected into a stationary medium show that particle acceleration occurs within the downstream jet. In the collisionless relativistic shock particle acceleration is due to plasma waves and their associated instabilities (e.g., the Weibel (filamentation) instability) created in the shocks are responsible for particle (electron, positron, and ion) acceleration. The simulation results show that the Weibel instability is responsible for generating and amplifying highly nonuniform, small-scale magnetic fields. These magnetic fields contribute to the electron's transverse deflection behind the jet head. The "jitter" radiation from deflected electrons has different properties than synchrotron radiation which is calculated in a uniform magnetic field. This jitter radiation may be important to understanding the complex time evolution and/or spectral structure in gamma-ray bursts, relativistic jets, and supernova remnants.

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